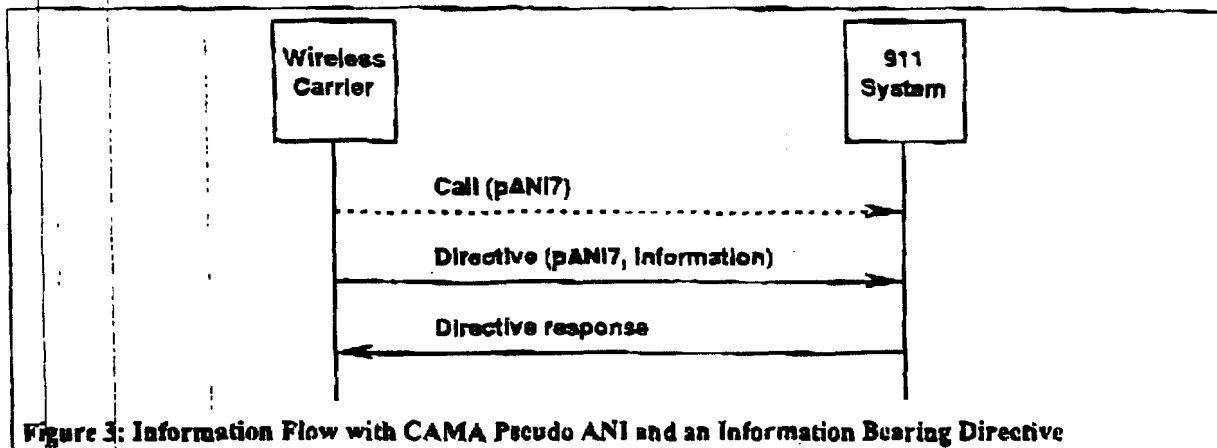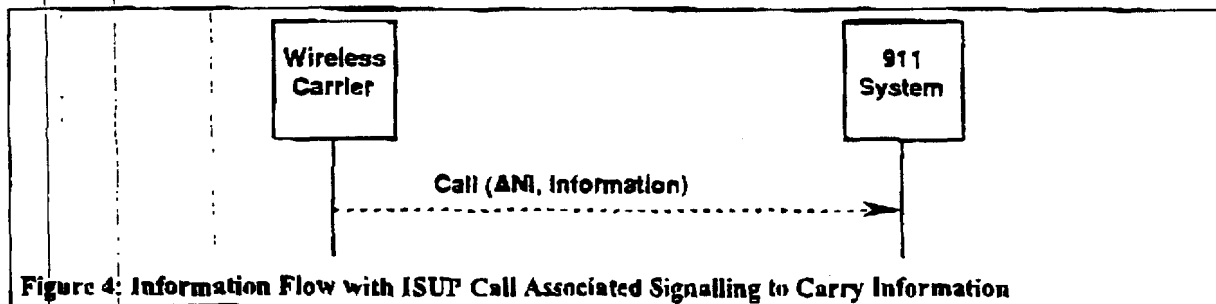be correlated. For instance, a directive could be used to convey specific information about the call (caller identification information, location information, etc.) This information may be correlated using the pseudo ANI. The information may be stored in a Automatic Location Information (ALI) database and be retrieved using normal E9-1-1 call procedures.

Figure 3: Information Flow with CAMA Pseudo ANI and an Information Bearing Directive

5.4   Call Setup with Additional Information

The emergency service call is made over a ISUP (ISDN (Integrated Services Digital Network) User Part) trunk modified to carry additional information about the call (caller identification information, location information, etc.). This method for information transfer is direct and does not require correlation of other messages. ISUP may not have sufficient bandwidth for the intended information flow and ISUP does not have procedures for additional messages to request and deliver location information.

Figure 4: Information Flow with ISUP Call Associated Signalling to Carry Information

5.5 | Call Setup with Additional Information

The emergency service call is made over a CAMA trunk. The 7 (or 8) digits of ANI information are used to convey a pseudo ANI. The pseudo ANI is usually used to identify the caller's serving cell (or sector) and the caller. The caller's identity is temporary, but it allows other information to be retrieved. For instance, more information may be requested that could be used to convey specific information about the call (caller identification information, location information, location updates, etc.).

Figure 5: Information Flow with CAMA and Non-Call Associated Retrieval of Information

5.6 | Call Setup with Additional Information

The emergency service call is made over a ISUP trunk. The ANI information identifies a caller. The caller's identity is temporary for some mobile subscribers, but it allows other information to be retrieved. For instance, more information may be requested that could be used to convey specific information about the call (caller identification information, location information, location updates, etc.).
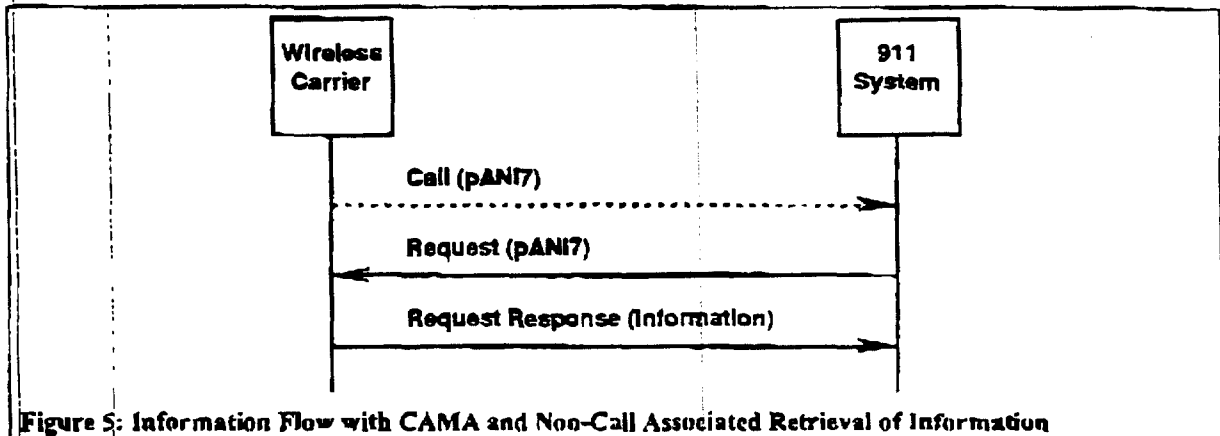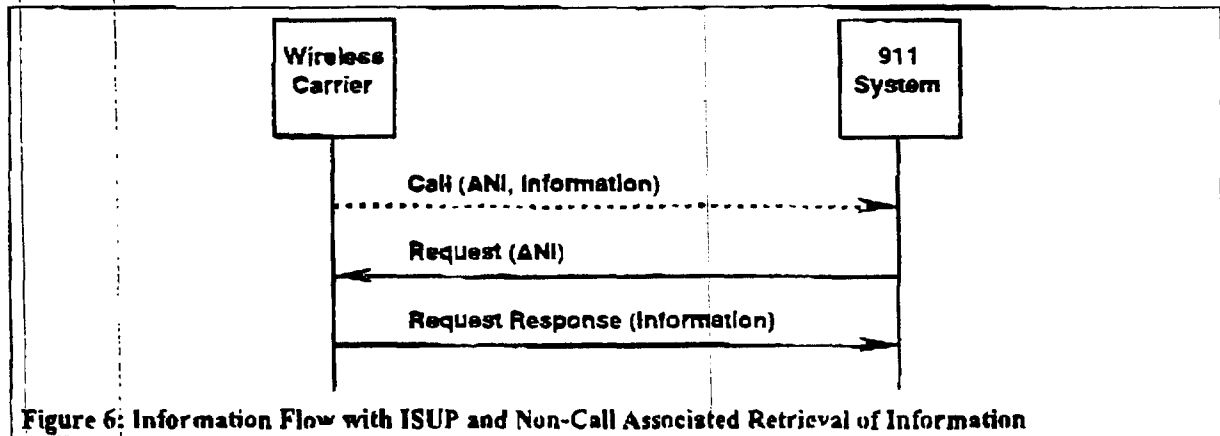

Figure 6: Information Flow with ISUP and Non-Call Associated Retrieval of Information

6. Information Element Locations

Note: reference points and network elements not germain to emergency service information element sources have been excluded for the sake of clarity. ANI refers to a full 10-digit (or greater) identification of the calling subscriber. ANI7 refers to a restricted 7- and 8-digit ANI.

The A, B, D, U_m, D_i, and A_i are existing interfaces.

X_a, X_b, X_c, X_d, X_f, X_h, X_i, X_k, and X_m are possible new interfaces.

MS
MIN-ESN

HLR
*MIN-ESN
home service provider information
subscriber information

terminal information

U_m

BS/BSC
pANI7=sector
Cell Id

D

VLR

A

B

Cell Information Database
*cell identification
cell location information

X_f

MSC

X_a and X_c may be A_i or D_i

X_a

ANI7=subscriber
or
pANI7=sector

Selective Router

X_c

X_b

X_h

X_d

Selective Router Database
*ANI7/pANI7
primary PSAP
secondary PSAPs

PSAP

Secondary PSAP

X_i

X_j

MIN Mobile Identification Number
ESN Electronic Serial Number
ALI Automatic Location Information
PSAP Public Safety Answering Point
MS   Mobile Station
BS   Base Station
BSC Base Station Controller
VLR Visitor Location Register
MSC Mobile Switching Center
TLDN Temporary Local Directory Number
HLR Home Location Register
PACA Priority Access and Channel Assignment
MDN Mobile Directory Number
pANI Pseudo Automatic Number Identification
pANI7 7-digit (or 8-digit) pseudo ANI
ANI7 7-digit (or 8-digit) ANI
*   database key
•   change from the previous figure

ALI
*ANI7
land line subscriber street address
land line subscriber name

local cellular subscriber name
or
cellular subscriber location (sector)

Figure 7: Evolutionary Path A Information Element Sources

MS
MIN-ESN

HLR
*MIN-ESN
home service provider information
subscriber Information
  mobile station priority -
  PACA level -
  preferred language -
terminal information
cellular subscriber name -

U_m

BS/BSC
pANI7=sector

VLR

D

A   B

Cell Information Database
*cell identification
cell location information
pANI -

X_f

MSC
TLDN -
serving service -
provider information -
pANI=Sector. subscriber -

X_a and X_c may be A_i or D_i

pANI7=sector
and implies
subscriber ID -

X_k -

X_a

**Selective
Router**

X_c

X_b

X_h

X_d

Selective Router Database
-ANI7/pANI7
primary PSAP
secondary PSAPs

PSAP

**Secondary
PSAP**

X_i X_l

MIN   Mobile Identification Number
ESN   Electronic Serial Number
ALI   Automatic Location Information
PSAP Public Safety Answering Point
MS   Mobile Station
BS   Base Station
BSC   Base Station Controller
VLR   Visitor Location Register
MSC   Mobile Switching Center
TLDN Temporary Local Directory Number
HLR   Home Location Register
PACA Priority Access and Channel Assignment
MDN   Mobile Directory Number
pANI   Pseudo Automatic Number Identification
pANI7 7-digit (or 8-digit) pseudo ANI
ANI7   7-digit (or 8-digit) ANI
*   database key
-        change from the previous figure

ALI
*ANI7 /pANI -
land line subscriber street address
land line subscriber name

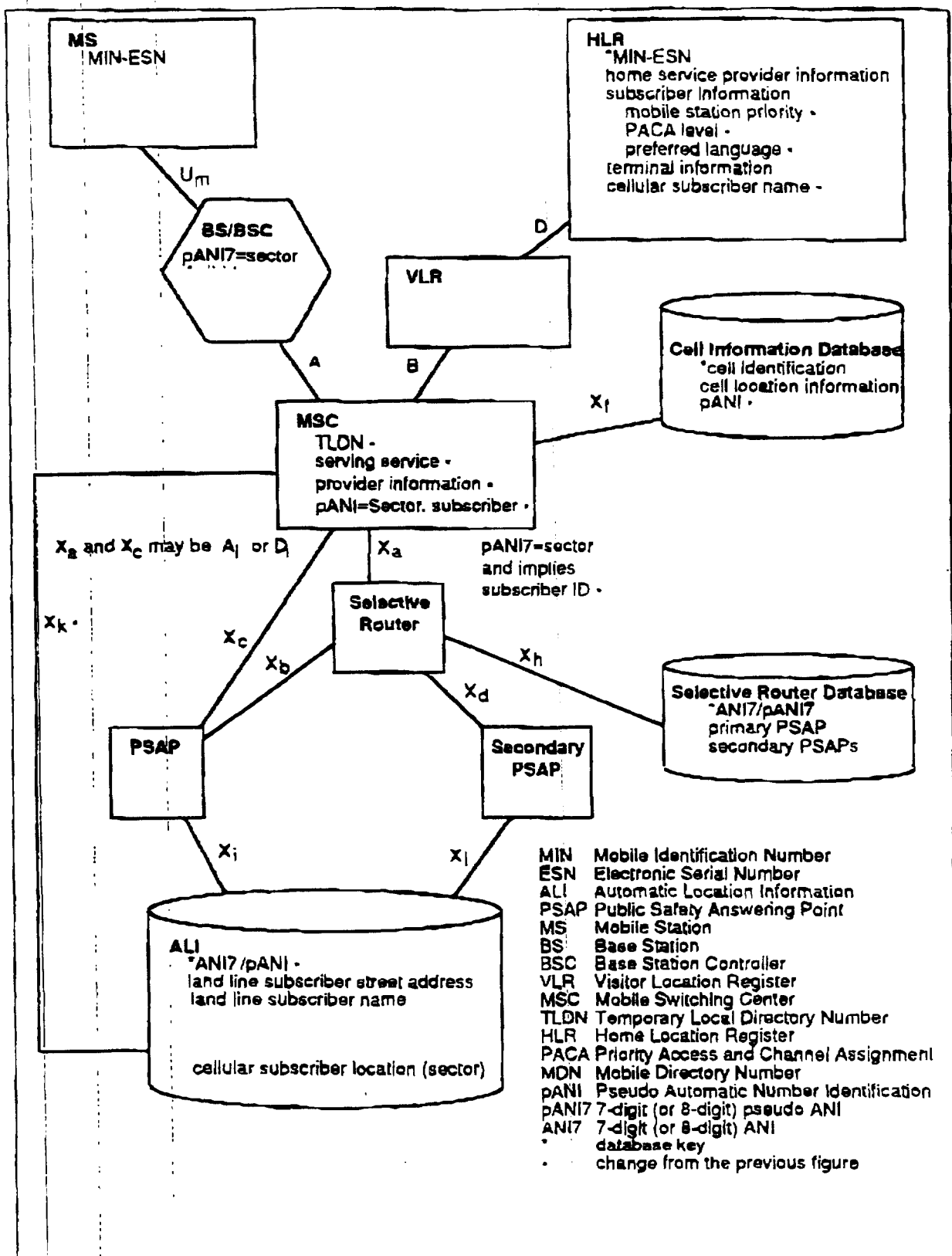cellular subscriber location (sector)

Figure 8: Evolutionary Path B Information Element Sources

4. Information Elements

The following is a list of possible information elements for transfer between a wireless cellular system and an emergency service system.

A. Subscriber Information

1. Mobile Identification Number–Electronic Serial Number (MIN-ESN)

2. International Mobile Station Identifier (IMSI)

3. Billing number

4. Subscriber name

5. Subscriber billing address

6. Subscriber home telephone number

7. Subscriber priority indication

8. Priority Access and Channel Assignment (PACA) level (A, B, or C)

9. Preferred Language

10. Personally provided medical information

11. Home wireless service provider information

B. Callback Number

1. Temporary Local Directory Number (TLDN)

2. Roamer Port Number

3. Emergency Service Access Port Number

4. Mobile Directory Number (MDN) (may be international)

C. Terminal Information

1. Electronic Serial Number (ESN)

2. Mobile Station Type

   a) Fixed

   b) Automobile

   c) Transportable

   d) Portable

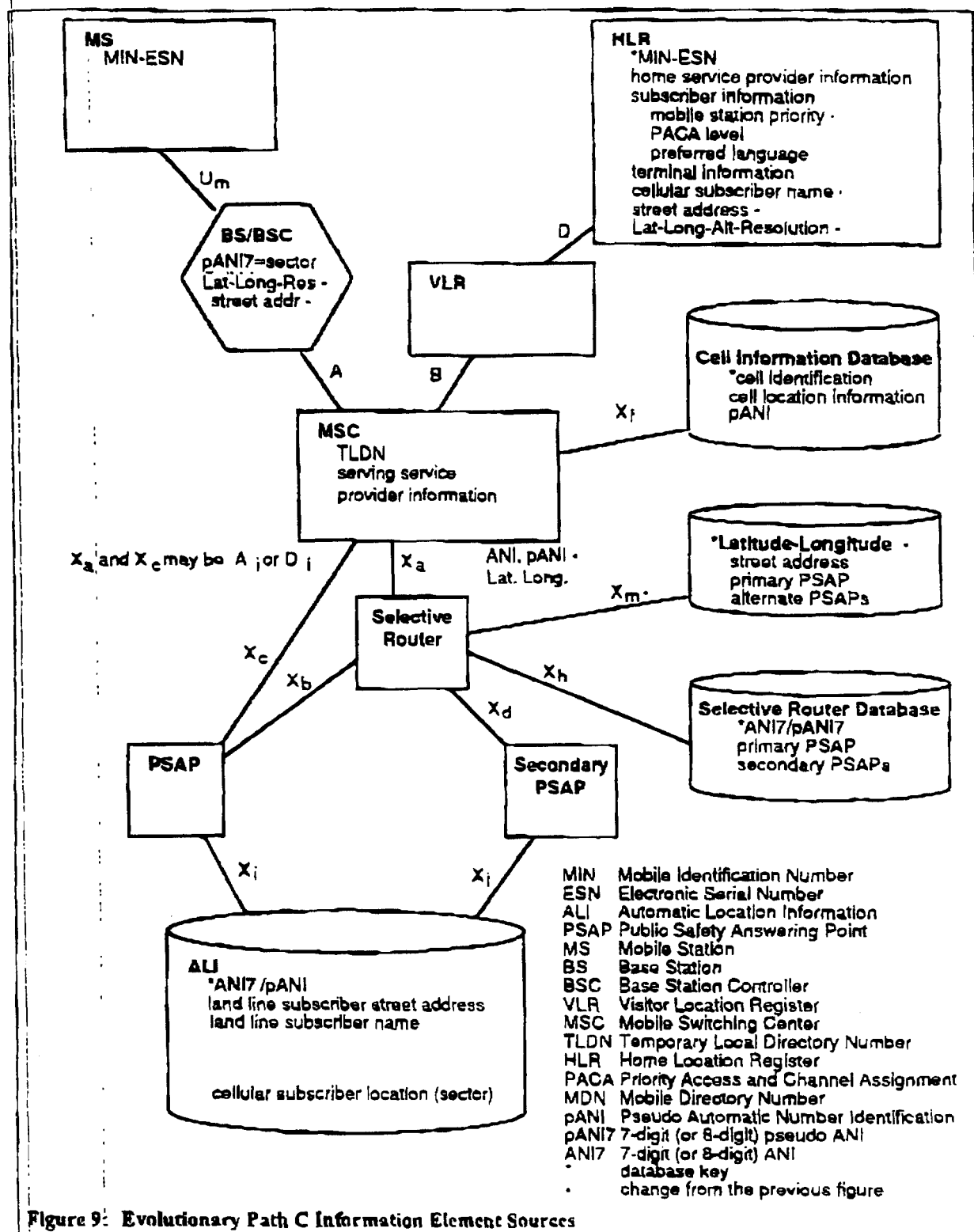   e) Aircraft

D. Caller Geographic Location

1. Latitude

2. Longitude

3. Altitude

4. Resolution

5. Source

    a) Mobile Station (MS)

    b) Base Station Controller (BSC)

    c) Mobile Switching Center (MSC)

    d) Home Location Register (HLR) —for fixed mobiles

    e) Selective Router

E. Caller Street Location

1. Street address

2. City

3. Source

    a) Mobile Station (MS)

    b) Base Station Controller (BSC)

    c) Mobile Switching Center (MSC)

    d) Home Location Register (HLR) —for fixed mobiles

    e) Selective Router

4. Serving Wireless Service Provider Information
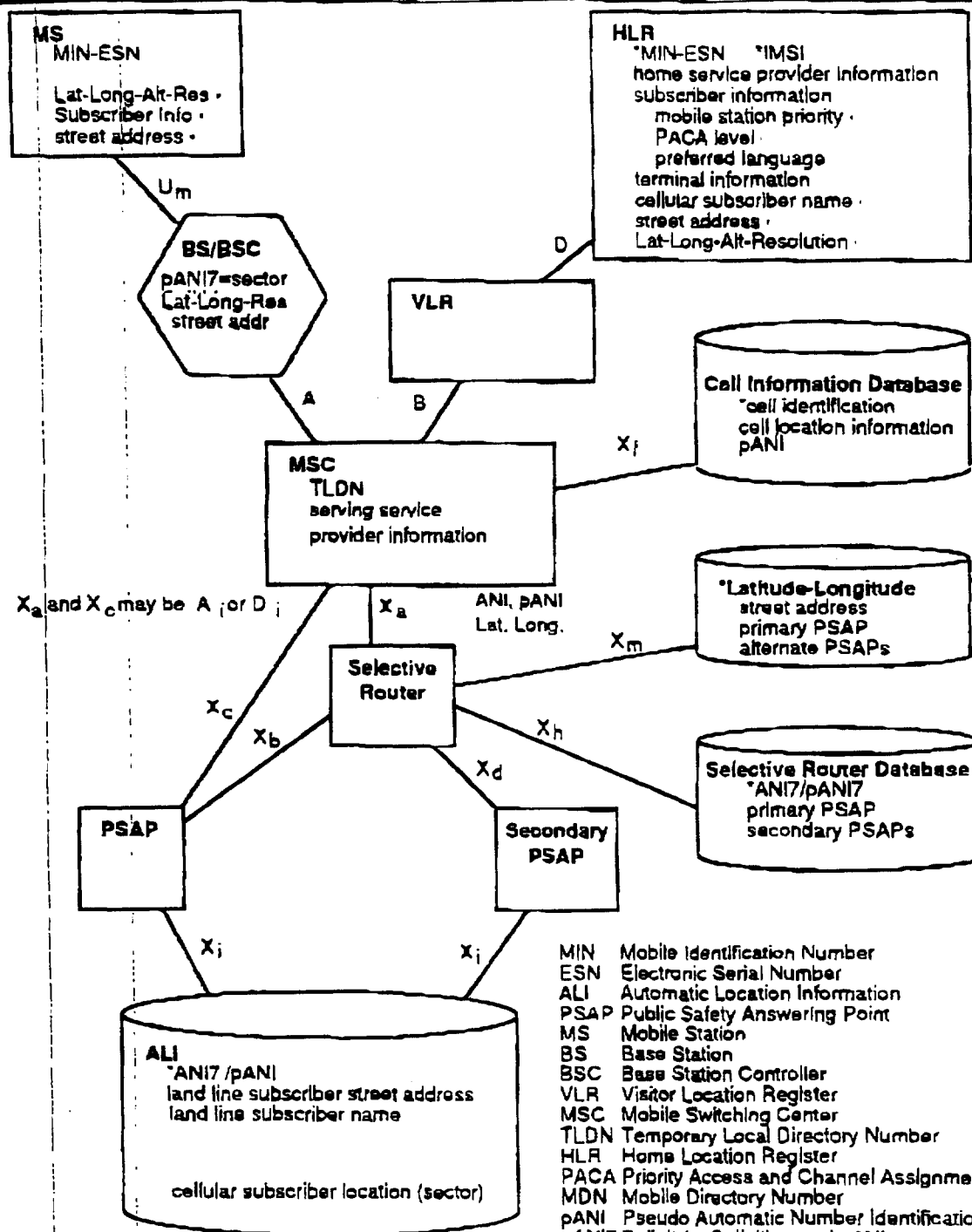
5. Access Directions

6. In-house security number

MS
  MIN-ESN

HLR
  *MIN-ESN
  home service provider information
  subscriber information
    mobile station priority ·
    PACA level
    preferred language
  terminal information
  cellular subscriber name ·
  street address -
  Lat-Long-Alt-Resolution -

U_m

BS/BSC
pANI7=sector
Lat-Long-Res -
street addr -

VLR

D

A   B

Cell Information Database
  *cell identification
  cell location information
  pANI

X_f

MSC
  TLDN
  serving service
  provider information

X_a and X_c may be A_i or D_i

X_a ANI, pANI ·
        Lat. Long.

*Latitude-Longitude ·
  street address
  primary PSAP
  alternate PSAPs

X_m·

Selective Router

X_c

X_b

X_h

X_d

Selective Router Database
  *ANI7/pANI7
  primary PSAP
  secondary PSAPs

PSAP

Secondary PSAP

X_i X_j

ALI
  *ANI7 /pANI
  land line subscriber street address
  land line subscriber name

  cellular subscriber location (sector)

MIN   Mobile Identification Number
ESN   Electronic Serial Number
ALI   Automatic Location Information
PSAP Public Safety Answering Point
MS   Mobile Station
BS   Base Station
BSC   Base Station Controller
VLR   Visitor Location Register
MSC   Mobile Switching Center
TLDN Temporary Local Directory Number
HLR   Home Location Register
PACA Priority Access and Channel Assignment
MDN   Mobile Directory Number
pANI Pseudo Automatic Number Identification
pANI7 7-digit (or 8-digit) pseudo ANI
ANI7 7-digit (or 8-digit) ANI
  ·   database key
  ·   change from the previous figure

Figure 9: Evolutionary Path C Information Element Sources

Figure 10: Evolutionary Path D Information Element Sources

MS
MIN-ESN

Lat-Long-Alt-Res ·
Subscriber Info ·
street address ·

HLR
*MIN-ESN   *IMSI
home service provider Information
subscriber information
mobile station priority ·
PACA level ·
preferred language
terminal information
cellular subscriber name ·
street address ·
Lat-Long-Alt-Resolution ·

U_m

BS/BSC
pANI7=sector
Lat-Long-Res
street addr

VLR

D

A   B

Call Information Database
*cell identification
cell location information
pANI

X_f

MSC
TLDN
serving service
provider information

X_a and X_c may be A_i or D_i

X_a ANI, pANI
Lat. Long.

*Latitude-Longitude
street address
primary PSAP
alternate PSAPs

X_m

Selective
Router

X_c X_b

X_h

X_d

Selective Router Database
*ANI7/pANI7
primary PSAP
secondary PSAPs

PSAP

Secondary
PSAP

X_i X_j

ALI
*ANI7 /pANI
land line subscriber street address
land line subscriber name

cellular subscriber location (sector)

MIN   Mobile Identification Number
ESN   Electronic Serial Number
ALI   Automatic Location Information
PSAP Public Safety Answering Point
MS   Mobile Station
BS   Base Station
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VLR   Visitor Location Register
MSC   Mobile Switching Center
TLDN Temporary Local Directory Number
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PACA Priority Access and Channel Assignment
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pANI   Pseudo Automatic Number Identification
pANI7 7-digit (or 8-digit) pseudo ANI
ANI7   7-digit (or 8-digit) ANI
*   database key
·   change from the previous figure

7. Location Technologies

A number of technologies to locate cellular subscribers were presented. Approaches ranged from equipment placed at the cell site (requiring little or no changes to the mobile station) to autonomous position determination equipment placed in the mobile station. The executive summary of a report commissioned by APCO was submitted. The APCO report contained synopses of 17 methods and products to determine position.

8. Contributions

The following documents were contributed to the meeting. (Documents were numbered with a TR45.ESJEM/94.08. prefix. The prefix is abbreviated as # within this report.)

No.	Description	Source
.01.01	Agenda & Work Plan	Chair
.01.02	Emergency Services Planning Meeting Report	Chair
.01.03	Mobility Tutorial	Cheryl Blum - AT&T
.01.04	TIA JEM in Support of 9-1-1 and E-9-1-1 Emergency Services: E9-1-1 Tutorial	Peter Reed - NENA
.01.05	Industry Practices	P J Louis - Bellcore
.01.06	Tutorial on Emergency Services for Wireless Cellular	Kirk Carlson - Synacom
.01.07	Evolutionary Path	Jeff Crollick - GTE TSI
.01.08	TR45.2 Recommendation	Jeff Crollick - GTE TSI
.01.09	Wireless ANI/ALI	Smith Advanced Technology
.01.10	A Report to NENA, APCO & TIA Regarding Automatic Location Identification Requirements of PSAPs	Michael Coleski
.01.11	Public 800 Mobile and PCS Support of 9-1-1 and E9-1-1 Emergency Services	Alison Brown - NAVSYS Corp.
.01.12	Effects of Wireless Communications and Advanced Technology on Enhanced 9-1-1 Systems	Joe Blaschka - Adcomm Engineering Co.
.01.13	AT&T Public Safety Systems 911 Data Network Solution	Larry Ciesla, Mike Meyer, and Carolyn Robins - AT&T
.01.14	AT&T Public Safety Systems Common Channel Signalling Network Solution	Larry Ciesla, Mike Meyer, and Carolyn Robins - AT&T
.01.15	Survey of Location Technologies to Support Mobile 9-1-1	Clem Driscoll - C.J. Driscoll & Assoc.
.01.16	JEM Planning Meeting Contributions	Planning Meeting
.01.17	An Approach to Locating Wireless Transmitters For Public Safety	Louis Stilp - Associated Communications Corp.
.01.18	SS7 Data Elements from Mobile/PCS Provider	Joe Blaschka - Adcomm Engineering Co.
.03.01	PCIA, APCO, NENA, NASNA Emergency Access Position Paper	PCIA
.03.02	An Overview of the PINS System and its Application for Use in Determining the Position of Cellular Equipment Users	D. Kelley - Terrapin Corp.

Attachment E of Ad Hoc Alliance September 26, 1996 FCC filing

911 CALL-BACK SOLUTION

The greatest stumbling block in the E-911 Report & Order and Further Notice of Proposed Rulemaking is how to ensure call-back, either to the disconnected 911 caller, or to verify information after the call is terminated. This issue exists for Roamers and all types of non-subscription handsets. There is absolutely no difference in call-back difficulty between a "paying" customer who is an "Unauthorized Roamer" and a "non-paying" handset, (with or without a "Code Identifier").

In the first instance, the "paying" customer who is roaming has a telephone number assignment which is a long distance call from the PSAP. This long distance call terminates in the distant Mobile Telephone Switching Office (MTSO) which originally assigned it to this customer. If the customer has activated "Call Follow", the call is switched from his MTSO to the MTSO in the city where he is roaming and call is completed. The "paying" customer, however, may not have activated the "Call Follow" process. Therefore, the PSAP may have to resort to using the "Roamer Access Port", which is a local number connected to the MTSO which allows the roamer's ten digit number to be directly entered into the MTSO, to attempt the call-back. However, there is no sure way for the PSAP operator to know which of the two system (A-side or B-side) is the "preferred" system for this roaming customer. The customer's handset will seek out and lock onto the "Preferred" system according to the system selection criteria established in the handset. This criteria may include a "Preferred System List" or a "Negative System List" both of which will over-ride the A-preferred or B-preferred selection. This additional selection process is quite common as the customer's home system provider is more and more frequently an owner of both A-side and B-side systems in different cities, and wants to keep the customer on an owned system when he roams rather than let the handset be served by some competitor's system. Therefore the PSAP may have to attempt the call-back sequentially over both the local A-side and B-side systems. If this caller's home system has no roaming agreement with either side in this city, he is an "Unauthorized Roamer" and neither side will complete the call from the PSAP to this handset. This is not a trivial annoyance but a real problem in an emergency situation.

In the case of a "Non-Subscriber" handset with a Mobile Identity Number (MIN) that is no longer valid for that handset Electronic Serial Number (ESN), the home system for the MIN will not steer the call to this "non-paying" handset. The call-back will be steered to the handset currently assigned this MIN and should that customer answer, they will have no knowledge of the 911 call. Also, any PSAP attempts to use either of the MTSO's roamer access ports will be thwarted when that MTSO authenticates the MIN by contacting the home system MTSO for that MIN. The local MTSO will only connect a call to a handset MIN/ESN that matches the assigned MIN/ESN as reported by the home system MTSO.

In the case of a "Non-Service Initialized" handset without a MIN at all, the PSAP can not call-back the handset as the PSAP has no dialable telephone number to call.

All of these issues could become moot if the cellular industry simply applied some of the same processes that have been utilized for years to handle the service known as "Follow-Me-Roaming", which allows a subscriber to roam in a distant city and have any calls directed to his handset delivered to him wherever he may be located.

The "Follow-Me-Roaming" process depends upon the use of "pseudo-ANI, which is a substitute telephone number used to uniquely identify a non-local handset MIN/ESN with a "local" telephone number. The service provides for the forwarding of calls directed to the roaming handset MIN/ESN by assigning a temporary substitute telephone number which is a dialable North American Numbering Plan (NANP) telephone number. The process works as follows:

1. Roaming Customer (RC) MIN (619) 262-1234 from city "A" enters city "R" and presses * 18 to register with the Mobile Telephone Switching Office (MTSO) in city "R" by reporting his MIN/ESN, and turn on "Call Follow".
2. City "R" MTSO assigns RC a temporary pseudo-ANI (NANP (202) 885-4321) as a local identifier and sends a "Call-Forward" order to city "A" instructing RC's home MTSO to forward any calls directed to MIN (619) 262-1234 (RC) to pseudo-ANI (NANP (202) 885-4321).
3. When someone calls RC MIN (619) 262-1234 and the call arrives at city "A" MTSO for completion, City "A" immediately forwards the call to NANP (202) 885-4321, which is routed by the telephone system to city "R" MTSO for completion.
4. When city "R" MTSO receives a call directed to NANP (202) 885-4321, it will translate this into a local call directed to RC MIN (619) 262-1234.
5. RC MIN (619) 262-1234 is always addressed by the MTSO as (619) 262-1234 and never knows nor cares about the pseudo-ANI (202) 885-4321 that is being used to route calls to this MTSO.
6. The pseudo-ANI for RC MIN (619) 262-1234 is assigned for a limited time period and will expire at the end of the day it was assigned. The city "R" MTSO will issue a call forward cancel order to city "A" MTSO when the pseudo-ANI expires.
7. Should RC MIN (619) 262-1234 remain in city "R" and register anew with the MTSO after midnight, the city "R" MTSO will repeat the process but will probably use a different pseudo-ANI for routing as the previous one was released and in all likely-hood was assigned to another roaming customer.

This process of using a substitute NANP telephone number (pseudo-ANI) to route calls within and between various systems is well known and has been practiced for a number of years. The assigning MTSO maintains a cross reference list of the pseudo-ANIs to handset MIN/ESN and circulates and reassigns the pseudo-ANIs as often as necessary.

Using this process of assigning a dialable substitute local telephone number to a handset MIN/ESN by the MTSO can resolve most of the 911 call-back issues. If the MTSO were to assign a temporary substitute telephone number (Pseudo-ANI) at the time of the 911 call origination and then report the substitute telephone number to the PSAP instead of reporting the actual handset MIN, or lack thereof, the PSAP operator could, in most instances, call-back the user in the event of disconnect. This substitute telephone number is a local number and is dialed as any other type of local call by the PSAP operator. If the substitute telephone number is delivered by the telephone company to BOTH of the MTSO's then both sides will seek to contact the handset MIN/ESN that has been assigned this substitute telephone number. The PSAP operator doesn't need to know the caller's actual MIN in this instance as it is the substitute telephone number that provides call-back.

The process of assigning a temporary substitute local telephone number (Pseudo-ANI) is as follows:

1. The A-side MTSO receives a 911 call origination order from a "Non-Service Initialized" handset MIN (000) 000-000 / ESN 1290654321.
2. The A-side MTSO assigns a substitute local number (202) 737-3232 to this handset MIN/ESN and stores the assignment data in its internal routing table.
3. The A-side MTSO notifies the B-side MTSO to store in its internal routing table this substitute telephone number assignment to this handset MIN/ESN.
4. The A-side MTSO completes the call to the appropriate PSAP and delivers the assigned substitute telephone number (202) 737-3232 as the calling party number.
5. Should the call get disconnected and the PSAP operator decide to call-back to this handset, the PSAP operator will dial the assigned substitute local telephone number (202) 737-3232.
6. The local telephone company delivers the call simultaneously to both the A-side and B-side MTSO's.
7. Upon receipt of a call directed to substitute telephone number (202) 737-3232, each MTSO extracts the handset MIN/ESN from its assignment routing table and each MTSO pages MIN (000) 000-0000.
8. Every handset in the system that contains a MIN (000) 000-0000 will respond automatically to this page.

   (Note: This is why the Alliance suggested to the Commission that every handset be manufactured with a unique MIN instead of the current practice of using a Null MIN. The Commission misunderstood this suggestion by assuming the MIN had to be a dialable telephone number.)

9. The MTSO can limit its page order to only the cell site over which it last had contact with this handset or it could page system wide. In either event, the paged handset will respond with an automatic page order acknowledgment which contains the handset MIN/ESN.
10. Only the correct handset MIN/ESN match will allow the MTSO to issue the voice channel order and only over the cell site through which the page order acknowledgment was received.
11. The desired handset will go to the assigned voice channel and when the user answers the call, conversation will be allowed and the local telephone company will drop the call to the other MTSO.

The substitute telephone number assignment will have a limited life and when the assignment window expires, the pseudo-ANI will be returned to the pool and available for reassignment. The volume of traffic expected and the length of the assignment window will determine how large the pool of temporary substitute numbers needs to be.

This call-back process could be implemented today be the cellular carriers at a fairly nominal cost. This solution is software based and resides in the MTSO intelligence. The elements of this process already exist and the creation of the MTSO control program should not exceed $250,000 for each switch manufacturer. The cost to implement the resultant program into the MTSO systems should not exceed $50,000 per system. The only recurring costs involved in the process is the pool of substitute local telephone numbers which both sides draw from for temporary assignment.

TR 45.2 report (ballot form)

TR45

Enhanced
Emergency Services

PN-3581.1

Functional Overview

Ballot Version

ENHANCED EMERGENCY SERVICES:
FUNCTIONAL OVERVIEW

CONTENTS

LIST OF FIGURES

None

LIST OF TABLES

None

FOREWORD

This Foreword is not part of this Interim Standard.

This is one of a series of recommendations entitled

"ENHANCED EMERGENCY SERVICES"

which provides a solution for the limited capabilities of wireless Enhanced Emergency Services. These capabilities include:

- provision of base station, cellsite or sector identification information

- subscriber identification

- callback

- reconnect

The recommendations included in this series are:

- PN-3581.1,   Enhanced Emergency Services: Functional Overview

- PN-3581.2,   Enhanced Emergency Services: PSAP Perspective

- PN-3581.3,   Enhanced Emergency Services: Intersystem Information Flows

- PN-3581.4,   Enhanced Emergency Services: *ANSI/TIA/EIA 41* Stage 2 Modifications

- PN-3581.5,   Enhanced Emergency Services: *ANSI J-STD-023* Stage 2 Modifications

- PN-3581.6,   Enhanced Emergency Services: *TIA/EIA/IS-93* Modifications

- PN-3581.7,   Enhanced Emergency Services: *ANSI/TIA/EIA 41* Stage 3 Modifications

- PN-3581.8,   Enhanced Emergency Services: *ANSI J-STD-024* Modifications

REVISION HISTORY

Revision	Date	Remarks
0	????	Initial Publication
A		
B		

NOTE

The numbering system of this series of Interim Standards varies from normal TIA/EIA practice. The unique numbering system assigned to these documents is intended to reflect their hierarchical structure.

1.   INTRODUCTION

1.1   OBJECTIVE

This Interim Standard (IS) presents recommendations for the support of Enhanced Emergency Services.

1.2   SCOPE

This document defines the range of application of the current issue of the series.   It focuses on overall objectives and basic assumptions.   Procedural details are presented in the other recommendations.

1.3   ORGANIZATION

This document is organized by the following sections:

- Sections 2, 3, and 4 entitled "References", "Definitions" and "Symbols and Abbreviations" respectively provide a referral to terminology and acronyms used in this document.